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Aquatic Macroinvertebrate Survey

10 Prairie Streams

McCone County, Montana

1995

prepared for the

Montana Department of Environmental Quality
Planning, Prevention and Assistance Division
P.O. Box 200901, Helena, MT 59620-0901

STATE DOCUMENTS COLLECTION

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INTRODUCTION

Benthic macroinvertebrate populations are known to be key indicators of stream ecosystem health (Hynes 1960). Life spans for some of these creatures are as long as three years, and their complex life cycles and limited mobility mean that there is ample time for the community to respond to cumulative effects of environmental perturbations. The analysis of macroinvertebrate communities can thus be related to a stream's biological health, or integrity, defined by Karr and Dudley (1981) as "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of natural habitat of the region."

The multimetric approach to bioassessment using benthic macroinvertebrates uses attributes of the assemblage in an integrated way to reflect overall biotic condition. Community attributes which can contribute meaningfully to bioassessment include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining components into an overall score reduces variance and increases precision of the assessment (Fore et al. 1995).

METHODS

Aquatic macroinvertebrates were sampled by personnel of the Montana Department of Environmental Quality (DEQ) from 10 creeks in McCone County of Northeastern Montana during August, 1995. The traveling kick-net method described by Bukantis (1997) was used. A single sample was collected from each stream within a representative riffled reach. The resulting samples are described and dated as follows:

1. Upper Big Warm Springs Creek - Above bridge along county road, 8/7/95
2. Beaver Creek - Near mouth above the Milk River, 8/8/95
3. Flat Creek - N.E. Content, 8/8/95
4. Lone Tree Creek - Below Triple Crossing Dam (Headwaters), 8/8/95
5. Prairie Elk Creek - At bridge near mouth, 8/10/95
6. Sand Creek - At Roosevelt Co. Oea Res., 8/21/95
7. Lower Big Muddy - At mouth, 8/22/95
8. East Fork of Redwater River - At mouth, 8/23/95
9. Horse Creek - 200 yards upstream from confluence with Redwater River, 8/23/95
10. Pasture Creek - 1/2 mile upstream of mouth at confluence with Redwater River, 8/23/95

Macroinvertebrate Sample Processing and Identification

Laboratory and data analyses were contracted to BlueStem Incorporated. Macroinvertebrate samples were processed by BlueStem Incorporated personnel using the U.S. Environmental Protection Agency's techniques for RBP III (Plafkin et al. 1989). Taxonomic identification of benthic macroinvertebrates were subcontracted by BlueStem Incorporated to EcoAnalysts Incorporated. Chironomidae and Oligochaeta identifications were subcontracted to Michael J. McBride.

Sample processing consisted of obtaining an approximate 300-organism subsample and was consistent with RBP III (Plafkin et al. 1989). Organisms were enumerated and identified whenever possible to the taxonomic level specified in the Montana DEQ SOP (Bukantis, 1997). The SOP requirements for subsampling and taxonomic resolution were strictly adhered to, deviating only when the quality of the specimen was lacking due to missing body parts needed for identification. When organisms were too immature to confidently take to the taxonomic level outlined in the SOP, they were more conservatively identified.

Following is a description of the subsampling procedure: Each sample was rinsed in a 0.5 mm sieve to remove preservative. The washed sample was then transferred to an appropriate size invertebrate sorting tray marked into square quadrants. Water was added to the tray to allow complete dispersion of the sample and even distribution of the organisms. Quadrants were randomly selected and organisms removed from each quadrant until the total number of organisms fell within the range of 270 to 330 (+/-10% of 300 organisms), or until there were no more invertebrates to remove, whichever occurred first. Any organism lying over a line separated by two quadrants was considered to be in the quadrant containing its head.

Data Analysis

Community structure, function and sensitivity to impact were characterized for each subsample using a battery of metrics developed by Montana DEQ for streams in the Plains Ecoregions of the state (Bukantis, 1997). Analysis of data for this report relied on an ecoregional reference and scoring criteria. Metric values were derived using data from the Montana Plains Ecoregions and revised by McGuire in his review of 1995. All metrics used by McGuire except for one were used in this analysis. No information was contributed by the Percent Scrapers and Shredders metric so it was eliminated. The ecoregional reference approach allows comparison of sites from this group of streams to plains streams elsewhere in the state.

Actual metric values were compared to the reference values to obtain metric scores (Table 1). Scores for each metric were summed to obtain the total score, which was used to derive the impairment classification and use support category (Table 2). Summaries for all 10 streams are found in Tables 3a and 3b.

Every attempt has been made to calculate metrics in a way that is comparable to the data of related studies. For this reason when counting for "Taxa Richness" all families and genera of the oligochaetes were combined together as one taxon. The same is true of the subgroups of *Cricotopus* sp.

RESULTS AND DISCUSSION

Macroinvertebrate communities

Macroinvertebrate taxa lists, metric results and other information for each sample are given in the Appendix.

Figure 1 displays total bioassessment scores, based on the Plains Ecoregions, for each site. There is no record of these streams being sampled and analyzed before, so this study was undertaken to establish baseline data from which future trend analyses may be performed.

Upper Big Warm Springs Creek: All metrics are consistent with moderate impairment due to significant organic enrichment. Tolerant and highly tolerant chironomids made up nearly 70% of the total assemblage, with the filter feeding *Tanytarsus* sp alone accounting for nearly 50%.

Beaver Creek: The high biotic index (7.05) indicates fairly significant organic pollution. The very low total abundance, the assemblage of tolerant and highly tolerant taxa and the fact that Corixidae (a piercer - herbivore) is the dominant taxa (44%) suggests warmer water, heavy plant growth and low oxygen.

Flat Creek: The extremely low total abundance (76), and the very high biotic index (8.64) indicating the dominance of highly tolerant taxa suggests significant organic enrichment of long standing.

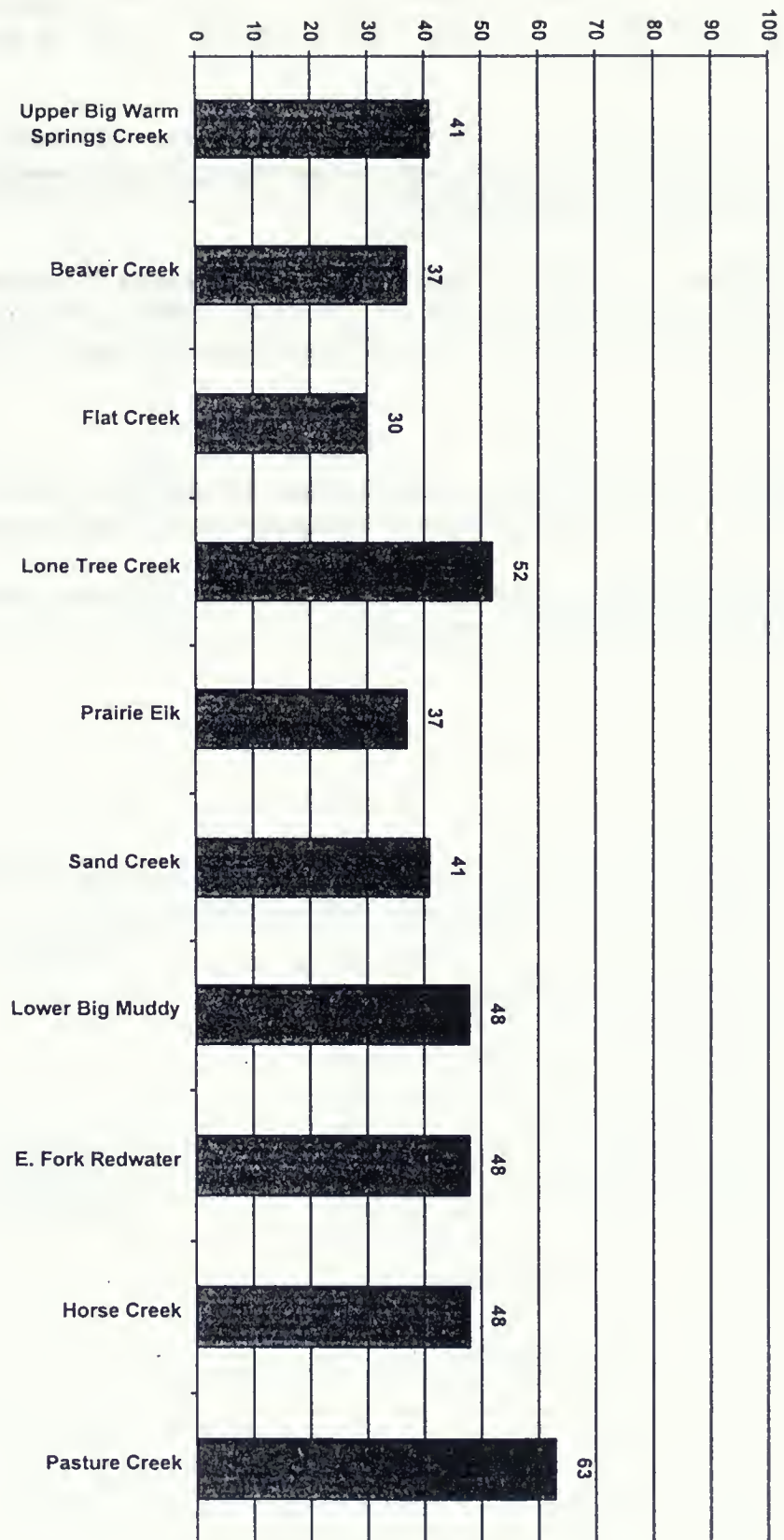
Lone Tree Creek: The high biotic index (7.64) indicates a highly tolerant community. The percent of reference score of 52 would suggest only slight to moderate impairment. But the taxa richness and predator taxa scores are deceptively high since all of the taxa are tolerant or highly tolerant of organic pollution and higher temperatures. *Cladotanytarsus* sp, *Callibaetis* sp, and *Physidae* sp predominate, suggesting that there is more impairment than the score indicates.

Prairie Elk Creek: Most of the metrics are consistent with moderate impairment due to organic enrichment. The EPT score is deceptively high because 73% of the total assemblage is *Cheumatopsche* sp, a highly tolerant species well adapted to slower, warmer streams.

Sand Creek: Most of the metrics are consistent with moderate impairment. The biotic index is fairly high. Sixty three percent of the total assemblage consists of the sediment tolerant *Caenis* sp and because of this. The EPT percent score is deceptively high.

Lower Big Muddy Creek: Moderate impairment due to organic enrichment and sediment is indicated by the metrics and the taxa. The biotic index is fairly high. The dominant taxon (39%) is the sediment - tolerant *Caenis* sp.

Figure 1. Total Bioassessment Scores: Plains Ecoregions McCone County, Montana



E. Fork Redwater River: The taxonomic make-up of the sampled assemblage and metric scores are very similar to that of the Lower Big Muddy. *Caenis* sp comprises an even greater portion (49%) of the total.

Horse Creek: A fairly recent source of organic enrichment could explain why the biotic index is fairly high, the abundance is very high, and yet there are no disproportionately dominant taxa. All taxa are tolerant or highly tolerant.

Pasture Creek: This stream is apparently the least impaired of this group but shows much of the same characteristics as its neighbors. The biotic index is fairly high, tolerant and highly tolerant taxa predominate and *Caenis* sp is again the dominant species (34%).

Conclusions

1. Organic and/or nutrient enrichment, indicated by high biotic index scores, is a ubiquitous problem in these streams apparently limiting the potential of all 10 streams.
2. Moderate impairment is indicated in all but one of the streams studied. Pasture Creek is slightly impaired according to this study.

Table 1

Metrics and scoring criteria for Plains Ecoregions streams (from McGuire 1995)				
metric	Scoring Criteria			
	3	2	1	0
Taxa richness	>24	24-18	18-12	<12
EPT richness	>8	8-6	5-3	<3
Biotic index	<5	5-6	6-7	>7
% dominant taxon	<30	30-45	45-60	>60
% Collector(g+ff)	<60	60-80	80-95	>95
% EPT	>50	50-30	30-10	<10
Shannon diversity (log2)	>3.0	3.0-2.4	2.4-1.8	<1.8
# predator taxa	>5	4-5	3-4	<3
% multivoltine	<40	40-60	60-80	>80

Table 2

Criteria for the assignment of support classifications / standards violation thresholds (from Bukantis, 1997)	
% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated
Criteria for the assignment of impairment classifications (from Plafkin et al. 1989)	
% Comparability to reference	Classification
>83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

Table 3a

Metric values and bioassessments, based on Plains Ecoregions reference, for McCone County Creeks, Aug. 7-10, 1995.

metric	Upper Big Warm Springs Creek	Beaver Creek near mouth	Flat Creek N.E. Content	Lone Tree Creek Below dam	Prairie Elk Near mouth
	8/7/95	8/8/95	8/8/95	8/8/95	8/10/95
Taxa richness	17	15	11	23	12
EPT richness	4	3	1	1	4
Biotic index	5.89	7.05	8.64	7.64	5.35
% dominant taxon	49	44	34	41	73
% Collector (g+ff)	85	43	68	78	96
% EPT	11	2	1	20	76
Shannon diversity(log2)	2.79	2.24	2.82	2.85	1.68
# predator taxa	2	3	0	8	1
% multivoltine	58	33	48	53	36
metric score					
Taxa richness	1	1	0	2	1
EPT richness	1	1	0	0	1
Biotic index	2	0	0	0	2
% dominant taxon	1	2	2	2	0
% Collector (g+ff)	1	3	2	2	0
% EPT	1	0	0	1	3
Shannon diversity(log2)	2	1	2	2	0
# predator taxa	0	1	0	3	0
% multivoltine	2	1	2	2	3
total score (max = 27)	11	10	8	14	10
% reference	41	37	30	52	37
classification *	MOD	MOD	MOD	SLI-MOD	MOD
use support	Partial Support	Partial Support	Partial Support	Partial Support	Partial Support

* classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired.

Table 3b

Metric values and bioassessments, based on Plains Ecoregions reference, for McCone County Creeks, Aug. 21-23, 1995.

metric	Sand Creek	Lower Big Muddy	Redwater River	Horse Creek	Pasture Creek
	Oea Res 8/21/95	Creek 8/22/95	East Fork 8/23/95	Near Redwater 8/23/95	Upstream of mouth 8/23/95
Taxa richness	15	19	19	22	24
EPT richness	2	3	1	2	2
Biotic index	6.54	7.72	6.75	7.19	6.85
% dominant taxon	63	39	49	20	34
% Collector (g+ff)	95	80	94	87	79
% EPT	73	41	49	13	35
Shannon diversity(log2)	1.85	2.88	2.76	3.86	3.23
# predator taxa	3	2	4	3	5
% multivoltine	18	21	28	45	21
metric score					
Taxa richness	1	2	2	2	2
EPT richness	0	1	0	0	0
Biotic index	1	0	1	0	1
% dominant taxon	0	2	1	3	2
% Collector (g+ff)	1	1	1	1	2
% EPT	3	2	2	1	2
Shannon diversity(log2)	1	2	2	3	3
# predator taxa	1	0	1	1	2
% multivoltine	3	3	3	2	3
total score (max = 27)	11	13	13	13	17
% reference	41	48	48	48	63
classification *	MOD	MOD	MOD	MOD	SLI
use support	Partial Support	Partial Support	Partial Support	Partial Support	Partial Support

* classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired.

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Appendix

Macroinvertebrate Taxonomic Data

UPPER BIG WARM SPRINGS CREEK - Above bridge along county road - 8/7/95

Taxon	#	%	BI ²	EFG ¹
MISC. TAXA				
Physidae	2	0.75	8	SC
Hyallolela azteca	28	10.57	8	CG
Acari	1	0.38	5	PA
TOTAL: MISC. TAXA	31	11.70		
ODONATA				
Coenagrionidae	5	1.89	7	PR
TOTAL: ODONATA TAXA	5	1.89		
EPHEMEROPTERA				
Fallceon quilleri	12	4.53	4	CG
Caenis	10	3.77	7	CG
TOTAL: EPHEMEROPTERA	22	8.30		
HEMIPTERA				
Ambrysus	6	2.26	3	PR
TOTAL: HEMIPTERA	6	2.26		
TRICHOPTERA				
Hydroptilidae	3	1.13	4	PH
Hydroptila	4	1.51	6	CG
TOTAL: TRICHOPTERA	7	2.64		
COLEOPTERA				
Dubiraphia	9	3.40	6	CG
TOTAL COLEOPTERA	9	3.40		
CHIRONOMIDAE				
Micropsectra	6	2.26	4	CG
Orthoclaadiinae	4	1.51	6	CG
Paratanytarsus	3	1.13	6	UN
Pentaneura	20	7.55	6	CG
Stempellinella	21	7.92	4	UN
Tanytarsus	129	48.68	6	CF
Thienemanniella	2	0.75	6	CG
TOTAL CHIRONOMIDAE	185	69.81		
GRAND TOTAL	265	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

UPPER BIG WARM SPRINGS CREEK - Above bridge along county road - 8/7/95

% of sample used:	31
Subsample size	265
Taxa richness	17
EPT richness	4
% Dominant taxon	49
Biotic Index	5.89
Metals tolerance index	2.91
% Collectors (Gatherer + Filter-feeders)	85
% Scrapers + Shredders	0.75
% EPT	11
Community Tolerance Quotient(a)	101.41
Shannon H (log2)	2.79
% Ephemeroptera	8
% Plecoptera	0
% Trichoptera	3
% Coleoptera	3
% Misc. Diptera	0
% Chironomidae	70
% univoltine	38
% multivoltine	58

Functional Feeding Grp.	%RA	# taxa
Filterers	49	1
Collector-Gatherers	36	9
Shredders	0	0
Scrapers	0.8	1
Predators	4	2

Est. total number of organisms	855
Est. number collected per foot	107
Est. number collected per minute	1710

Macroinvertebrate Taxonomic Data

BEAVER CREEK - near mouth above Milk River - 8/8/95

Taxon	#	%	BI ²	FEG ¹
MISC. TAXA				
Physidae	4	2.80	8	SC
Cladocera	2	1.40	8	CF
Hyallolela azteca	4	2.80	8	CG
Acari	2	1.40	5	PA
TOTAL: MISC. TAXA	12	8.39		
ODONATA				
Enallagma	6	4.20	7	PR
TOTAL: ODONATA TAXA	6	4.20		
EPHEMEROPTERA				
Baetidae	1	0.70	4	CG
TOTAL: EPHEMEROPTERA	1	0.70		
HEMIPTERA				
Corixidae	63	44.06	8	PH
Gerridae	2	1.40	11	PR
TOTAL: HEMIPTERA	65	45.45		
TRICHOPTERA				
Ithytrichia	1	0.70	4	SC
Oecetis	1	0.70	8	PR
TOTAL: TRICHOPTERA	2	1.40		
COLEOPTERA				
Dubiraphia	2	1.40	6	CG
TOTAL COLEOPTERA	2	1.40		
CHIRONOMIDAE				
Dicrotendipes	1	0.70	8	CG
Micropsectra	1	0.70	4	CG
Paratanytarsus	3	2.10	6	UN
Polypedilum	50	34.97	6	CG
TOTAL CHIRONOMIDAE	55	38.46		
GRAND TOTAL	143	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

BEAVER CREEK - near mouth above Milk River - 8/8/95

% of sample used:	100
Subsample size	143
Taxa richness	15
EPT richness	3
% Dominant taxon	44
Biotic Index	7.05
Metals tolerance index	4.31
% Collectors (Gatherer + Filter-feeders)	43
% Scrapers + Shredders	4
% EPT	2
Community Tolerance Quotient(a)	96.53
Shannon H (log2)	2.24
% Ephemeroptera	0.70
% Plecoptera	0
% Trichoptera	1
% Coleoptera	1
% Misc. Diptera	0
% Chironomidae	38
% univoltine	66
% multivoltine	33

Functional Feeding Grp.	%RA	# taxa
Filterers	1	1
Collector-Gatherers	41	6
Shredders	0	0
Scrapers	4	2
Predators	6	3

Est. total number of organisms	143
Est. number collected per foot	14
Est. number collected per minute	143

Macroinvertebrate Taxonomic Data

FLAT CREEK - NE Content - 8/8/95

Taxon	#	%	BI ²	EFG ¹
MISC. TAXA				
Tubificidae	4	5.26	10	CG
Lymnaeidae	1	1.32	6	SC
Physidae	5	6.58	8	SC
Cladocera	11	14.47	8	CF
Hyallolela azteca	3	3.95	8	CG
TOTAL: MISC. TAXA	24	31.58		
EPHEMEROPTERA				
Callibaetis	1	1.32	9	CG
TOTAL: EPHEMEROPTERA	1	1.32		
HEMIPTERA				
Corixidae	15	19.74	8	PH
TOTAL: HEMIPTERA	15	19.74		
DIPTERA				
Diptera	3	3.95	11	UN
TOTAL DIPTERA	3	3.95		
CHIRONOMIDAE				
Chironomidae	4	5.26	8	CG
Chironomus	26	34.21	10	CG
Micropsectra	3	3.95	4	CG
TOTAL CHIRONOMIDAE	33	43.42		
GRAND TOTAL	76	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

FLAT CREEK - NE Content - 8/8/95

% of sample used:	100
Subsample size	76
Taxa richness	11
EPT richness	1
% Dominant taxon	34
Biotic Index	8.64
Metals tolerance index	3.90
% Collectors (Gatherer + Filter-feeders)	68
% Scrapers + Shredders	8
% EPT	1
Community Tolerance Quotient(a)	104.40
Shannon H (log2)	2.82
% Ephemeroptera	1
% Plecoptera	0
% Trichoptera	0
% Coleoptera	0
% Misc. Diptera	4
% Chironomidae	43
% univoltine	52
% multivoltine	48

Functional Feeding Grp.	%RA	# taxa
Filterers	14	1
Collector-Gatherers	54	6
Shredders	0	0
Scrapers	8	2
Predators	0	0

Est. total number of organisms	76
Est. number collected per foot	8
Est. number collected per minute	76

Macroinvertebrate Taxonomic Data

LONE TREE CREEK - below Triple Crossing Dam (Headwaters) - 8/8/95

Taxon	#	%	BI ²	FEG ¹
MISC. TAXA				
Tubificidae	5	1.72	10	CG
Physidae	32	11.00	8	SC
Hyallolela azteca	13	4.47	8	CG
TOTAL: MISC. TAXA	50	17.18		
ODONATA				
Enallagma	10	3.44	7	PR
TOTAL: ODONATA TAXA	10	3.44		
EPHEMEROPTERA				
Callibaetis	59	20.27	9	CG
TOTAL: EPHEMEROPTERA	59	20.27		
HEMIPTERA				
Corixidae	10	3.44	8	PH
Gerris	1	0.34	5	PR
Notonecta	1	0.34	5	PR
TOTAL: HEMIPTERA	12	4.12		
COLEOPTERA				
Dytiscidae	1	0.34	5	PR
Agabus	1	0.34	5	PR
Agabus	2	0.69	5	PR
TOTAL COLEOPTERA	4	1.37		
DIPTERA				
Ceratopogonidae	5	1.72	6	PR
Chaoboridae	2	0.69	8	PR
Culicidae	1	0.34	8	CG
TOTAL DIPTERA	8	2.75		
CHIRONOMIDAE				
Chironomini	1	0.34	6	CG
Chironomus	1	0.34	10	CG
Cladotanytarsus	119	40.89	7	CG
Cricotopus	16	5.50	7	CG
Dicrotendipes	1	0.34	8	CG
Endochironomus	6	2.06	10	CG
Micropsectra	2	0.69	4	CG
Orthoclaadiinae	1	0.34	6	CG
Tanytarsus	1	0.34	6	CF
TOTAL CHIRONOMIDAE	148	50.88		
GRAND TOTAL	291	100.00		

¹ Functional feeding group designations are given on page A-21

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

LONE TREE CREEK - below Triple Crossing Dam (Headwaters) - 8/8/95

% of sample used:	65
Subsample size	291
Taxa richness	23
EPT richness	1
% Dominant taxon	41
Biotic Index	7.64
Metals tolerance index	3.17
% Collectors (Gatherer + Filter-feeders)	78
% Scrapers + Shredders	11
% EPT	20
Community Tolerance Quotient(a)	98.18
Shannon H (log2)	2.85
% Ephemeroptera	20
% Plecoptera	0
% Trichoptera	0
% Coleoptera	1
% Misc. Diptera	3
% Chironomidae	51
% univoltine	45
% multivoltine	53

Functional Feeding Grp.	%RA	# taxa
Filterers	0.34	1
Collector-Gatherers	77	12
Shredders	0	0
Scrapers	11	1
Predators	8	8

Est. total number of organisms	448
Est. number collected per foot	45
Est. number collected per minute	448

Macroinvertebrate Taxonomic Data

PRAIRIE ELK CREEK - at bridge near mouth - 8/10/95

Taxon	#	%	BI ²	FFG ¹
EPHEMEROPTERA				
Baetis	7	2.42	5	CG
Caenis	1	0.35	7	CG
TOTAL: EPHEMEROPTERA	8	2.77		
TRICHOPTERA				
Cheumatopsyche	210	72.66	5	CF
Hydroptila	1	0.35	6	CG
TOTAL: TRICHOPTERA	21	73.01		
DIPTERA				
Ceratopogonidae	1	0.35	6	PR
Simulium	7	2.42	5	CF
TOTAL: DIPTERA	2	2.77		
CHIRONOMIDAE				
Cricotopus	20	6.92	7	CG
Cricotopus Bicinctus Gr.	11	3.81	7	CG
Cricotopus trifascia group	1	0.35	6	CG
Dicrotendipes	4	1.38	8	CG
Micropsectra	1	0.35	4	CG
Nanocladius	1	0.35	3	CG
Pentaneurini	10	3.46	6	UN
Polypedilum	14	4.84	6	CG
TOTAL CHIRONOMIDAE	62	21.45		
GRAND TOTAL	289	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

PRAIRIE ELK CREEK - at bridge near mouth - 8/10/95

% of sample used:		35
Subsample size		289
Taxa richness		12
EPT richness		4
% Dominant taxon		73
Biotic Index		5.35
Metals tolerance index		5.19
% Collectors (Gatherer + Filter-feeders)		96
% Scrapers + Shredders		0
% EPT		.76
Community Tolerance Quotient(a)		102.86
Shannon H (log2)		1.68
% Ephemeroptera		3
% Plecoptera		0
% Trichoptera		1
% Coleoptera		0.39
% Misc. Diptera		0
% Chironomidae		27
% univoltine		64
% multivoltine		36
Functional Feeding Grp.	%RA	# taxa
Filterers	75	2
Collector-Gatherers	21	10
Shredders	0	0
Scrapers	0	0
Predators	0.35	1
Est. total number of organisms		826
Est. number collected per foot		69
Est. number collected per minute		826

Macroinvertebrate Taxonomic Data

SAND CREEK - Roosevelt Co. Oea Res. - 8/21/95

Taxon	#	%	BI ²	FFG ¹
MISC. TAXA				
Tubificidae	3	1.09	10	CG
Hyallolela azteca	5	1.81	8	CG
TOTAL: MISC. TAXA	8	2.90		
ODONATA				
Coenagrionidae	6	2.17	7	PR
TOTAL: ODONATA TAXA	6	2.17		
EPHEMEROPTERA				
Caenis	175	63.41	7	CG
TOTAL: EPHEMEROPTERA	175	63.41		
HEMIPTERA				
Corixidae	1	0.36	8	PH
TOTAL: HEMIPTERA	1	0.36		
MEGALOPTERA				
Sialis	2	0.72	4	PR
TOTAL: MEGALOPTERA	2	0.72		
TRICHOPTERA				
Cheumatopsyche	21	7.61	5	CF
TOTAL: TRICHOPTERA	21	7.61		
COLEOPTERA				
Coleoptera	1	0.36	11	UN
Dubiraphia	1	0.36	6	CG
TOTAL COLEOPTERA	2	0.72		
DIPTERA				
Ceratopogonidae	2	0.72	6	PR
TOTAL: DIPTERA	2	0.72		
CHIRONOMIDAE				
Cricotopus	1	0.36	7	CG
Dicrotendipes	5	1.81	8	CG
Endochironomus	2	0.72	10	CG
Pentaneurini	1	0.36	6	UN
Pseudochironomus	50	18.12	5	CG
TOTAL CHIRONOMIDAE	59	21.38		
GRAND TOTAL	276	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

SAND CREEK - Roosevelt Co. Oea Res. - 8/21/95

% of sample used:	21
Subsample size	276
Taxa richness	15
EPT richness	2
% Dominant taxon	63
Biotic Index	6.54
Metals tolerance index	3.55
% Collectors (Gatherer + Filter-feeders)	95
% Scrapers + Shredders	0
% EPT	71
Community Tolerance Quotient(a)	104.92
Shannon H (log2)	1.85
% Ephemeroptera	63
% Plecoptera	0
% Trichoptera	8
% Coleoptera	0.72
% Misc. Diptera	0.72
% Chironomidae	21
% univoltine	82
% multivoltine	18

Functional Feeding Grp.	%RA	# taxa
Filterers	8	1
Collector-Gatherers	88	8
Shredders	0	0
Scrapers	0	0
Predators	4	3

Est. total number of organisms	1314
Est. number collected per foot	66
Est. number collected per minute	1314

Macroinvertebrate Taxonomic Data

LOWER BIG MUDDY - mouth - 8/22/95

Taxon	#	%	BJ ²	FFG ¹
MISC. TAXA				
Dero nivea	2	0.78	10	CG
Nais variabilis	55	21.48	10	CG
Tubificidae	6	2.34	10	CG
TOTAL: MISC. TAXA	63	24.61		
ODONATA				
Enallagma	7	2.73	7	PR
TOTAL: ODONATA TAXA	7	2.73		
EPHEMEROPTERA				
Caenis	101	39.45	7	CG
TOTAL: EPHEMEROPTERA	101	39.45		
HEMIPTERA				
Corixidae	12	4.69	8	PH
TOTAL: HEMIPTERA	12	4.69		
TRICHOPTERA				
Hydropsychidae	1	0.39	4	CF
Cheumatopsyche	2	0.78	5	CF
TOTAL: TRICHOPTERA	3	1.17		
COLEOPTERA				
Dubiraphia	1	0.39	6	CG
TOTAL COLEOPTERA	1	0.39		
CHIRONOMIDAE				
Ablabesmyia	1	0.39	8	CG
Chironomus	1	0.39	10	CG
Cricotopus	5	1.95	7	CG
Cricotopus Bicinctus Gr.	2	0.78	7	CG
Cryptochironomus	1	0.39	8	PR
Cryptotendipes	2	0.78	6	UN
Dicrotendipes	17	6.64	8	CG
Glyptotendipes	4	1.56	10	CG
Micropsectra	4	1.56	4	CG
Paratanytarsus	28	10.94	6	UN
Polypedilum	1	0.39	6	CG
Procladius	1	0.39	9	CG
Rheotanytarsus	2	0.78	6	CF
TOTAL CHIRONOMIDAE	69	26.95		
GRAND TOTAL	256	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

LOWER BIG MUDDY - mouth - 8/22/95

% of sample used:	25
Subsample size	256
Taxa richness	19
EPT richness	3
% Dominant taxon	39
Biotic Index	7.72
Metals tolerance index	3.41
% Collectors (Gatherer + Filter-feeders)	80
% Scrapers + Shredders	0
% EPT	41
Community Tolerance Quotient(a)	104.55
Shannon H (log2)	2.88
% Ephemeroptera	39
% Plecoptera	0
% Trichoptera	1
% Coleoptera	0.39
% Misc. Diptera	0
% Chironomidae	27
% univoltine	79
% multivoltine	21

Functional Feeding Grp.	%RA	# taxa
Filterers	2	3
Collector-Gatherers	78	14
Shredders	0	0
Scrapers	0	0
Predators	3	2

Est. total number of organisms	1024
Est. number collected per foot	51
Est. number collected per minute	1024

Macroinvertebrate Taxonomic Data

EAST FORK OF REDWATER RIVER - at mouth - 8/23/95

Taxon	#	%	BI ²	FFG ¹
MISC. TAXA				
Dero digitata	3	1.19	10	CG
Dero nivea	2	0.79	10	CG
Tubificidea	3	1.19	10	CG
TOTAL: MISC. TAXA	8	3.16		
ODONATA				
Dromogomphus	1	0.40	4	PR
Enallagma	2	0.79	7	PR
TOTAL: ODONATA TAXA	3	1.19		
EPHEMEROPTERA				
Caenis	125	49.41	7	CG
TOTAL: EPHEMEROPTERA	125	49.41		
HEMIPTERA				
Corixidae	3	1.19	8	PH
TOTAL: HEMIPTERA	3	1.19		
MEGALOPTERA				
Sialis	1	0.40	4	PR
TOTAL: MEGALOPTERA	1	0.40		
COLEOPTERA				
Dubiraphia	20	7.91	6	CG
TOTAL COLEOPTERA	20	7.91		
CHIRONOMIDAE				
Ablabesmyia	1	0.40	8	CG
Chironomini	2	0.79	6	CG
Cladotanytarsus	26	10.28	7	CG
Cryptochironomus	4	1.58	8	PR
Cryptotendipes	5	1.98	6	UN
Dicrotendipes	5	1.98	8	CG
Micropsectra	4	1.58	4	CG
Paralauterborniella	1	0.40	8	CG
Polypedilum	22	8.70	6	CG
Procladius	3	1.19	9	CG
Pseudochironomus	19	7.51	5	CG
Tanytarsus	1	0.40	6	CF
TOTAL CHIRONOMIDAE	93	36.76		
GRAND TOTAL	253	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

EAST FORK OF REDWATER RIVER - at mouth - 8/23/95

% of sample used:	15
Subsample size	253
Taxa richness	19
EPT richness	1
% Dominant taxon	49
Biotic Index	6.75
Metals tolerance index	3.39
% Collectors (Gatherer + Filter-feeders)	94
% Scrapers + Shredders	0
% EPT	49
Community Tolerance Quotient(a)	104.20
Shannon H (log2)	2.76
% Ephemeroptera	49
% Plecoptera	0
% Trichoptera	0
% Coleoptera	8
% Misc. Diptera	0
% Chironomidae	37
% univoltine	64
% multivoltine	28

Functional Feeding Grp.	%RA	# taxa
Filterers	0.40	1
Collector-Gatherers	93	14
Shredders	0	0
Scrapers	0	0
Predators	3	4

Est. total number of organisms	1687
Est. number collected per foot	84
Est. number collected per minute	1687

Amendment A.

Benthic macroinvertebrate catch per unit effort expressed as the number of organisms per foot kicked and per second kicked, for the sample collected August 23, 1995 from Horse Creek, Montana.

Site Name: Horse Creek, 200 yards upstream from confluence with Redwater.

RTE.	CC	DATE
	FILE	
ADM.	WTR.	AIR

Number of Grids subsampled out of 48 total grids:	24
Percent of sample subsampled:	50 %
Total number of organisms subsampled:	102
Estimated total number of organisms in whole sample:	204
Estimated number of organisms per foot kicked:	204
Estimated number of organisms per second kicked:	37

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Macroinvertebrate Taxonomic Data

HORSE CREEK - 200 yards upstream from confluence with Redwater - 8/23/95

Taxon	#	%	BI ²	FEG ¹
MISC. TAXA				
Tubificidae	10	10.31	10	CG
Copepoda	2	2.06	8	CG
Hyallolella azteca	1	1.03	8	CG
TOTAL: MISC. TAXA	13	13.40		
ODONATA				
Coenagrionidae	2	2.06	7	PR
TOTAL: ODONATA TAXA	2	2.06		
EPHEMEROPTERA				
Callibaetis	6	6.19	9	CG
Caenis	7	7.22	7	CG
TOTAL: EPHEMEROPTERA	13	13.40		
HEMIPTERA				
Corixidae	4	4.12	8	PH
TOTAL: HEMIPTERA	4	4.12		
COLEOPTERA				
Dubiraphia	13	13.40	6	CG
TOTAL COLEOPTERA	13	13.40		
DIPTERA				
Ceratopogonidae	1	1.03	6	PR
Simuliidae	1	1.03	6	CF
TOTAL: DIPTERA	2	2.06		
CHIRONOMIDAE				
Chironomini	19	19.59	6	CG
Chironomus	1	1.03	10	CG
Cladotanytarsus	3	3.09	7	CG
Corynoneura	1	1.03	6	CG
Cricotopus	7	7.22	7	CG
Cryptotendipes	4	4.12	6	UN
Dicrotendipes	5	5.15	8	CG
Endochironomus	2	2.06	10	CG
Micropsectra	1	1.03	4	CG
Polypedilum	1	1.03	6	CG
Pseudochironomus	4	4.12	5	CG
Tanytus	2	2.06	10	PR
TOTAL CHIRONOMIDAE	50	51.55		
GRAND TOTAL	97	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

HORSE CREEK - 200 yards upstream from confluence with Redwater - 8/23/95

% of sample used:	4
Subsample size	97
Taxa richness	22
EPT richness	2
% Dominant taxon	20
Biotic Index	7.19
Metals tolerance index	4.51
% Collectors (Gatherer + Filter-feeders)	87
% Scrapers + Shredders	0
% EPT	13
Community Tolerance Quotient(a)	104.55
Shannon H (log2)	3.86
% Ephemeroptera	13
% Plecoptera	0
% Trichoptera	0
% Coleoptera	13
% Misc. Diptera	2
% Chironomidae	52
% univoltine	41
% multivoltine	45

Functional Feeding Grp.	%RA	# taxa
Filterers	1	1
Collector-Gatherers	86	16
Shredders	0	0
Scrapers	0	0
Predators	5	3

Est. total number of organisms	2425
Est. number collected per foot	121
Est. number collected per minute	2425

Macroinvertebrate Taxonomic Data

PASTURE CREEK - 1/2 mile upstream of mouth at confluence with Redwater - 8/23/95

Taxon	#	%	BI ²	FFG ¹
MISC. TAXA				
Physidae	1	0.34	8	SC
Hyalloa azteca	55	18.84	8	CG
TOTAL: MISC. TAXA	56	19.18		
ODONATA				
Boyeria ³	2	0.68	2	PR
Coenagrionidae	31	10.62	7	PR
Enallagma	6	2.05	7	PR
TOTAL: ODONATA TAXA	39	13.36		
EPHEMEROPTERA				
Callibaetis	4	1.37	9	CG
Caenis	99	33.90	7	CG
TOTAL: EPHEMEROPTERA	103	35.27		
HEMIPTERA				
Corixidae	1	0.34	8	PH
TOTAL: HEMIPTERA	1	0.34		
MEGALOPTERA				
Sialis	2	0.68	4	PR
TOTAL: MEGALOPTERA	2	0.68		
COLEOPTERA				
Curculionidae	1	0.34	11	SH
TOTAL COLEOPTERA	1	0.34		
DIPTERA				
Ceratopogonidae	11	3.77	6	PR
Simuliidae	1	0.34	6	CF
TOTAL: DIPTERA	12	4.11		
CHIRONOMIDAE				
Chironomidae	1	0.34	8	CG
Ablabesmyia	1	0.34	8	CG
Chironominae	10	3.42	8	CG
Cladotanytarsus	9	3.08	7	CG
Dicrotendipes	2	0.68	8	CG
Micropsectra	18	6.16	4	CG
Pentaneurini	6	2.05	6	UN
Polypedilum	2	0.68	6	CG

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

³ The known distribution of this genus is Eastern North America (Merritt & Cummins 1996).

Continued...

PASTURE CREEK - 1/2 mile upstream of mouth at confluence with Redwater - 8/23/95

Taxon	#	%	BI ²	FFG ¹
CHIRONOMIDAE				
Procladius	2	0.68	9	CG
Pseudochironomus	19	6.51	5	CG
Psectrocladius	5	1.71	8	CG
Tanytarsus	3	1.03	6	CF
TOTAL CHIRONOMIDAE	78	26.71		
GRAND TOTAL	292	100.00		

¹ Functional feeding group designations are given on page A-21.

² Biotic index scores for individual taxa as given in Bukantis 1997.

Aquatic Macroinvertebrate Data

PASTURE CREEK - 1/2 mile upstream of mouth at confluence with Redwater - 8/23/95

% of sample used:	15
Subsample size	292
Taxa richness	24
EPT richness	2
% Dominant taxon	34
Biotic Index	6.85
Metals tolerance index	3.04
% Collectors (Gatherer + Filter-feeders)	79
% Scrapers + Shredders	0.68
% EPT	35
Community Tolerance Quotient(a)	101.45
Shannon H (log2)	3.23
% Ephemeroptera	35
% Plecoptera	0
% Trichoptera	0
% Coleoptera	0.34
% Misc. Diptera	4
% Chironomidae	27
% univoltine	78
% multivoltine	21

Functional Feeding Grp.	%RA	# taxa
Filterers	1	2
Collector-Gatherers	78	13
Shredders	0.34	1
Scrapers	0.34	1
Predators	18	5

Est. total number of organisms	1947
Est. number collected per foot	97
Est. number collected per minute	1947

PR - Predator
 CG - Collector-gatherer
 CF - Collector-filterer
 SC - Scraper
 SH - Shredder
 PH - Piercer-Herbivore
 UN - Unknown

Amendment A. Benthic macroinvertebrate catch per unit effort expressed as the number of organisms per foot kicked and per second kicked, for the sample collected July 2, 1996 from Horse Creek, Montana.

Site Name: Horse Creek, 200 yards upstream from confluence with Redwater.

Number of Grids subsampled out of 48 total grids:	24
Percent of sample subsampled:	50 %
Total number of organisms subsampled:	102
Estimated total number of organisms in whole sample:	204
Estimated number of organisms per foot kicked:	204
Estimated number of organisms per second kicked:	37

